

WE CLAIM:

1. A spatial reference system comprised of:

at least one artifact assembly having a measuring bar assembly including an inner member with a proximate end and a distal end, an outer member with a proximate end and a distal end, and a compensating member with a proximate end and a distal end operatively disposed between said inner and said outer members, such that said distal end of said outer member is fixedly mounted to said distal end of said compensating member, said proximate end of said compensating member is fixedly mounted to said proximate end of said inner member; and

said inner and said outer members each having a predetermined length and a predetermined coefficient of thermal expansion and said compensating member having a predetermined length and a predetermined coefficient of thermal expansion, such that the thermal expansion of said inner and said outer members is substantially eliminated by the expansion of said compensating member.

2. A spatial reference system as set forth in claim 1 wherein said artifact assembly further includes a first end adapter and a first end probe, and a second end adapter and a second end probe, said first end adapter operatively mounted to said proximate end of said outer member to accept said first end probe, and said second end adapter operatively mounted to said distal end of said inner member to accept said second end probe, said first end probe and said second end probe thereby adapted to provide the end points of said measuring bar as a measurement standard.

3. A spatial reference system as set forth in claim 2 wherein the said compensating member is further defined as having a predetermined length and a predetermined coefficient of thermal expansion, such that the expansion of said first and said second end adapters and said first end probe and said second end probe in addition to the expansion of said inner and said outer members is cancelled out and compensated for by the expansion of said compensating member.

4. A spatial reference system as set forth in claim 2 wherein the distance from the point at which said proximate end of said outer member is fixedly mounted to said first end adapter to the point at which said distal end of said outer member is fixedly mounted to said distal end of said compensating member is the same as the distance from the point at which said proximate end of said compensating member is fixedly mounted to said proximate end of said inner member to the point at which said distal end of said inner member is fixedly mounted to said second end adapter, such that said inner member and said outer member have the same effective length.

5. A spatial reference system as set forth in claim 2 wherein said first end probe and said second end probe are spherical.

6. A spatial reference system comprising:
at least one artifact assembly having a measuring bar assembly including a first inner member with a proximate end and a distal end, a second inner member with a proximate end and a distal end, and a compensating outer member with a proximate end and a distal end;
a first end probe fixedly mounted to said proximate end of said first inner member;

a second end probe fixedly mounted to said distal end of said second inner member;

said first inner member and said second inner member juxtaposed to each other and cooperatively disposed within said compensating outer member such that said distal end of said first inner member is fixedly mounted to said distal end of said outer compensating member and said proximate end of said second inner member is fixedly mounted to said proximate end of said compensating outer member; and

said first inner member and said second inner member each having a predetermined length and a predetermined coefficient of thermal expansion and said compensating outer member having a predetermined length and a predetermined coefficient of thermal expansion, such that the expansion of said first inner member and said second inner member is substantially eliminated by the expansion of said compensating outer member.

7. A spatial reference system as set forth in claim 6 further including a first end adapter assembly disposed between said first inner member and said first end probe and a second end adapter assembly disposed between said second inner member and said second end probe.

8. A spatial reference system as set forth in claim 7 wherein said first and said second end probes are spherical.

9. A spatial reference system comprising:

at least one artifact assembly having a measuring bar with a first end and a second end, a first end adapter assembly and a second end adapter assembly operatively mounted to said first and said

second ends of said measuring bar, a first end probe mounted to said first end adapter assembly, and a second end probe mounted to said second end adapter assembly;

said first end adapter assembly and said second end adapter assembly each having a predetermined thermal expansion which is cooperative to provide a predetermined change in length that is equal and opposite to the linear expansion of said measuring bar and said first and said second end probes thereby substantially eliminating any thermal expansion of said artifact.

10. A spatial reference system as set forth in claim 9 wherein each of said end adapter assemblies include:

an outer member formed in a generally cylindrical shape with an open distal end and a closed proximate end thereby forming a central cavity, said outer member adapted to fit within an open end of the measuring bar such that said distal end of said outer member is fixedly mounted to one of said ends of said measuring bar,

an inner member with a proximate end and a distal end, said cavity of said outer member adapted to receive said proximate end of said inner member so that said proximate end of said inner member fits within said outer member and is fixedly mounted to said proximate end of said outer member within said cavity with said distal end of said inner member extending beyond said distal end of said outer member to support and retain one of said end probes.

11. A spatial reference system as set forth in claim 10 wherein said proximate end of said inner member is fixedly mounted to said proximate end of said outer member within said cavity by a threaded fastener.

12. A spatial reference system as set forth in claim 10 wherein said distal end of said inner member is further defined by having an annular surface which is adapted to retain and center one of said end probes.

13. A spatial reference system as set forth in claim 12 wherein said first and said second end probes are spherical and formed of a ferro-metallic material that may be magnetically influenced.

14. A spatial reference system as set forth in claim 13 wherein said distal end of said inner member is further defined by having recessed cavity adapted to accept and retain a magnet disposed below said annular surface such that said magnet attracts and retains said end probe.

15. A spatial reference system as set forth in claim 10 wherein said inner member further includes a through bore formed laterally across said distal end, said through bore adapted to accept and receive a cylindrical member, said cylindrical member selectively operable to expand and press outward against the sides of said outer member thereby causing said end adapter assembly to be frictionally retained in the end of said measuring bar.

16. A spatial reference system as set forth in claim 15 wherein said outer member is further defined as having a pair of bisectonal slots formed through said open distal end and extending a predetermined length of said outer member such that said selective expansion of said

cylindrical member causes said outer member to spread apart at its said distal end to frictionally retain said end adapter assembly in said measuring bar member.

17. A spatial reference system as set forth in claim 16 wherein said outer member further includes an opening in its said distal end to provide operative access to a set screw threadingly disposed in one end of said cylindrical member as retained in said inner member, said opening being of a smaller diameter than said set screw such that an outward turning of said set screw causes said set screw and said cylindrical member to press outward against the sides of said outer member thereby causing said end adapter assembly to frictionally retain said end adapter assembly in said measuring bar member.

18. A spatial reference system as set forth in claim 11 wherein three of said measuring bar assemblies and three of said end probes are operatively combined to form a two dimensional triangular reference standard.

19. A spatial reference system as set forth in claim 11 wherein five of said measuring bar assemblies and four of said end probes are operatively combined to form a two-dimensional parallelogram reference standard.

20. A spatial reference system as set forth in claim 11 wherein six of said measuring bar assemblies and four of said end probes are operatively combined to form a three-dimensional tetrahedron reference standard.